Orbigator Control Board – Hardware Specification (v1.3)

Overview

Compact dual-stepper controller for the Orbigator project.
Manages two axes: RAAN (Right Ascension of Ascending Node) and Mean Anomaly (MA).
Built around a Raspberry Pi Pico 2 and two Pololu DRV8834 stepper-driver carriers.
Includes a combined 1.3″ OLED (SSD1106, 128×64) + rotary encoder module, and a DS3231 RTC.
Single-supply operation from a 5 V DC barrel jack.

Primary Bill of Materials

Qty	Item	Notes
1	Raspberry Pi Pico 2 (RP2350)	3.3 V logic; USB-C optional
2	Pololu DRV8834 Low-Voltage Stepper Carriers	White board; 2.5–10.8 V VMOT
1	SY28STH32-067A Stepper (RAAN)	3.8 V @ 0.67 A/phase, 200 steps/rev
1	NFP-GW12T-10BY Stepper (MA)	5 V @ 0.13 A/phase, 1:118 gearbox
1	Combined OLED + Encoder Module	1.3″, 128×64, 65×35 mm; 4×M3 @ 60×30 mm
1	DS3231 RTC Module + CR2032 Holder	I²C RTC (0x68). Avoid charging CR2032; use non-charging v
1	5.5 mm Barrel Jack	Center-pos, 5 V DC input
2	47 µF Electrolytic Capacitors	Bulk decoupling for DRV8834 VMOT
6–8	0.1 µF Ceramic Capacitors	Local decoupling (MCU/I²C/encoder/RTC)

Electrical Summary

Power: Single 5 V input (center-positive) powers Pico 2 and both DRV8834 drivers.
Logic bus: I²C0 at 3.3 V shared by OLED (0x3C) and DS3231 (0x68).
Pull-ups: Provide a single set of SDA/SCL pull-ups to 3.3 V (≈4.7 kΩ). Remove/omit any 5 V pull-ups on add-on modules.
Total current: ≈0.7 A average (low duty), 1–2 A supply recommended for margin.
Cooling: Not required due to low duty cycle.

Stepper Driver Configuration (DRV8834)

Axis	Motor	I_phase (A)	VREF (V)	Notes
RAAN	SY28STH32-067A	0.67	0.335	Full-size stepper, 200 steps/rev
Mean Anomaly	NFP-GW12T-10BY	0.13	0.065	Worm-gear stepper, 1:118

OLED + Encoder Module

Combined 1.3″ OLED (SSD1106, 128×64) + rotary encoder board with a single 9-pin interface.
Module size: 65×35 mm; mounting holes: 60×30 mm rectangle (M3).
Supply: 3.3–5 V confirmed; I²C address 0x3C.

Pin	Signal	Description	Pico GPIO
1	Confirm	Encoder push (active LOW)	GP18
2	OLED_SDA	I²C data	GP4
3	OLED_SCL	I²C clock	GP5
4	Encoder_Push	Duplicate of Confirm (if present)	—
5	Encoder_TRA	Encoder channel A	GP16
6	Encoder_TRB	Encoder channel B	GP17
7	BAK	Backup line (leave NC)	—
8	GND	Ground	—
9	3V3-5V	Module power (prefer 3.3 V bus)	—

Real-Time Clock (RTC) – DS3231

Device: DS3231 (TCXO) I²C RTC, address 0x68.
Supply: 2.3–5.5 V. For 3.3 V I²C bus integrity, power the module from 3.3 V (recommended).
Backup: CR2032 cell. Use *non-charging* module revision (or disable/remove charge path) to avoid charging primary cells.
I²C Speed: 100–400 kHz. Shared bus with OLED; standard 100 kHz is fine.
Signals: SDA, SCL to I²C0; optional INT/SQW to an interrupt-capable GPIO for alarms.

Pin	Signal	Description	Pico GPIO
1	SDA	I²C data (3.3 V)	GP4
2	SCL	I²C clock (3.3 V)	GP5
3	VCC	3.3 V supply (preferred)	3V3
4	GND	Ground	GND
5	INT/SQW	Interrupt/alarm output (optional)	GP21
6	BAT	CR2032 backup (on module)	—

Pico 2 Pin Assignments

Axis	Signal	GPIO
RAAN	STEP	GP14
RAAN	DIR	GP15
RAAN	nENBL	GP13
RAAN	nSLEEP	GP12

RAAN	M0	GP6
RAAN	M1	GP7
Mean Anomaly	STEP	GP10
Mean Anomaly	DIR	GP11
Mean Anomaly	nENBL	GP9
Mean Anomaly	nSLEEP	GP8
Mean Anomaly	M0	GP19
Mean Anomaly	M1	GP20
OLED + Encoder	I²C SDA	GP4
OLED + Encoder	I²C SCL	GP5
OLED + Encoder	Encoder A	GP16
OLED + Encoder	Encoder B	GP17
OLED + Encoder	Confirm Button	GP18
RTC	INT/SQW (optional)	GP21

I²C Bus Notes: Ensure only one set of SDA/SCL pull-ups to 3.3 V (≈4.7 kΩ total). If any module has pull-ups to 5 V, remove or rewire to 3.3 V to protect Pico GPIOs. Some DS3231 boards include a charging circuit for LIR2032 cells; do not charge CR2032 cells.